U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE MICROSCOPIST

FOR

1891.

BY

THOMAS TAYLOR, M. D.

FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1891.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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REPORT OF THE MICROSCOPIST.

SIR: I have the honor to submit herewith my twentieth annual report as chief of the Division of Microscopy.

The work done during the past year relates in a great measure to the microscopical investigation of food adulterations, food fats and oils, textile fibers, and edible and poisonous mushrooms.

In relation to fiber investigations, I have had constructed, with your permission, a new machine of my invention for determining the general value and tensile strength of farmers' binder twine and for other purposes connected with farming interests. In these tests I have been courteously assisted by the officer in charge of the Bureau of Equipment of the Boston Navy-yard, and also by Mr. E. B. Balch, superintendent of the National Cordage Company, New York City. This machine is now in good working order. A number of experiments have been made with it, and the results of the preliminary trials are herewith furnished. It may be well to state here that this machine has no relation to another machine invented by me and illustrated herein, designed solely for testing and comparing the relative strengths of fibers and of threads. There is also furnished in this report an interesting statement of preliminary tests made with this machine of four samples of foreign flax, showing their relative strength as compared with their relative cost per ton. These samples of flax were received from Mr. J. M. Anderson, Belfast, Ireland.

During the past year I have also devoted considerable time to investigating and reporting upon wool fibers, and have testified officially in the United States courts, for the Secretary of the Treasury, in cases where such examinations were pertinent to a question of dutiable merchandise. Valuable samples of foreign and native wools have been added to the collection in this division through the courtesy of Mr. E. A. Greene, Philadelphia, Pa.; also of Mr. John Consalus, Troy, N. Y., and others.

It may also be proper for me to mention that I have in progress the preparation of a large collection of models representing, by casts taken from nature, the edible and poisonous mushrooms of the United States, in groupings and otherwise, illustrating their manner of growth, development, coloring, and as far as possible their diversity of habitat. In this line of work enough has already been done to shape roughly an exhibit for the World's Columbian Exposition, which exhibit, it is desirable, should be as comprehensive and perfect as the one in the museum at Nice, France, which shows the mushrooms prepared in plaster, life-size, and colored after nature. In this way the public is enabled readily to compare one kind of mushroom with another, and to study them in all their stages of growth.

With the approval and coöperation of the Assistant Secretary, I have, as already said, commenced my preparations for such an exhibit, which will be made as complete as the means placed at my disposal will permit.

Respectfully submitted.

THOMAS TAYLOR,
Chief.

Hon. J. M. RUSK,
Secretary.

IMPROVED METHODS OF DISTINGUISHING BETWEEN PURE AND FICTITIOUS LARD.

In consideration of the many requests received during the past year for such information as would enable one skilled in the use of the microscope to distinguish pure lard from fictitious lard, I have prepared a preliminary statement of experiments for those who desire to make microscopic observations in this line of research:

(1) Heat, over the flame of a Bunsen burner, in a porcelain capsule, 4 ounces of pure home-rendered leaf lard, for a period of one minute, and allow it to cool slowly until it solidifies, which will require a period of about four hours, in an atmosphere of about 75° F. The crystalline groupings of this sample will appear very small when viewed under a power of 100 diameters.

(2) Prepare, in like manner, another sample of pure leaf lard, heating it for a period of four minutes, and allowing it to cool slowly, as above. It will be observed that pure lard in this case shows well-defined crystals of stearin, viewed under the microscope as above, and will, without regard to the high temperatures to which it has been exposed, consolidate in about the same time as that given in the first experiment.

(3) Prepare a sample of compound lard consisting of commercial stearin and sufficient cotton-seed oil to bring the stearin to the consistency of good pure lard; heat four minutes, and allow this mixture to cool slowly as above. It will consolidate in about an hour at 75° F.

(4) Prepare a second sample of compound lard, consisting principally of commercial stearin to which a trace of pure lard has been added; heat this compound for a period of four minutes. This compound will also consolidate quickly, owing to the presence of stearin in large quantity.

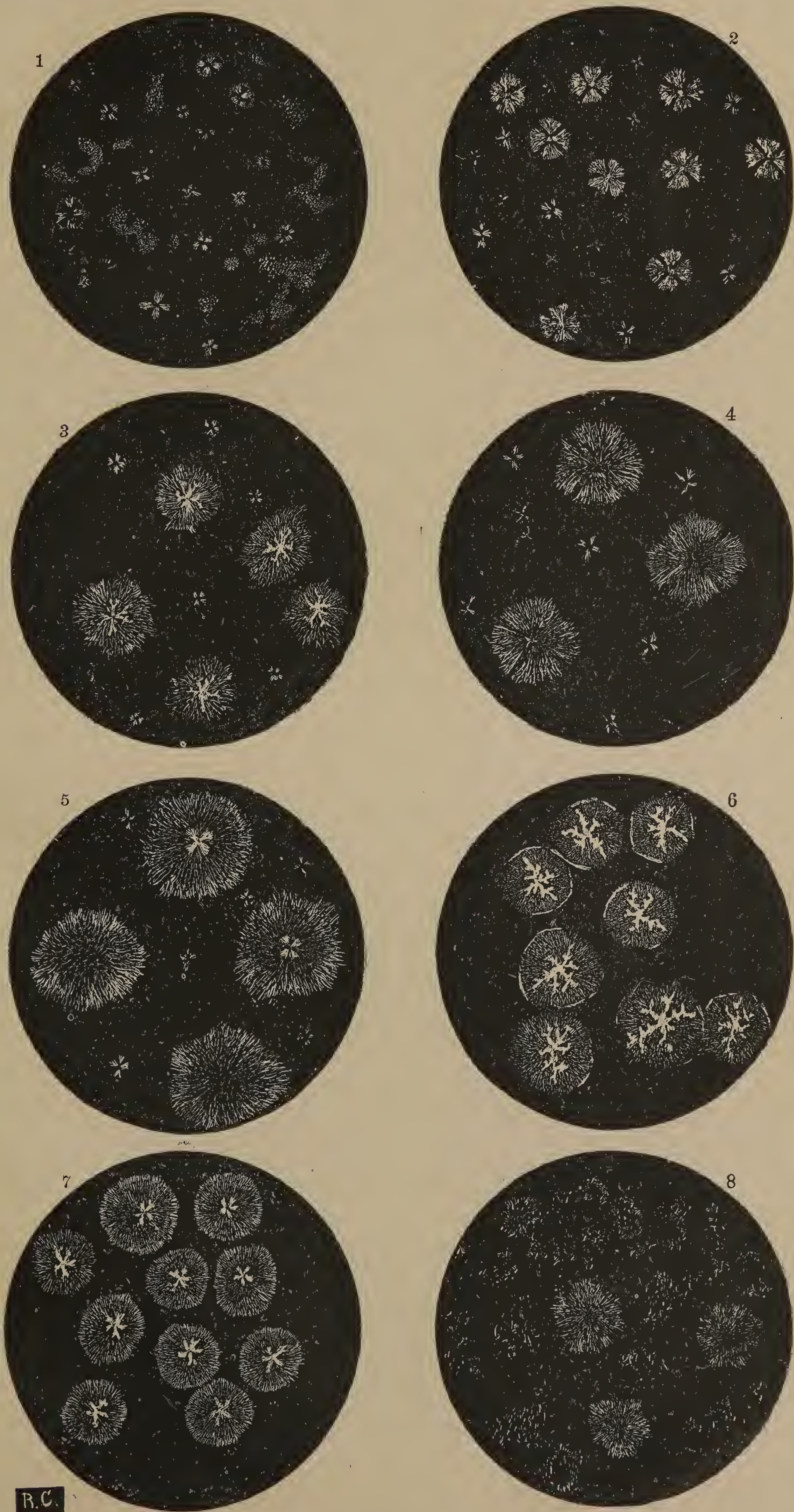
(5) Prepare a third sample of compound lard, consisting of commercial stearin, oleo, and cotton-seed oil, with a trace of pure lard; heat four minutes, and allow it to cool slowly, at 75° F. In this case it will be observed that the time required for consolidation will depend upon the amount of stearin present.

(6) Prepare a sample of commercial oleo after the method of the first experiment. This, like pure lard, will require about four hours, at 75° F., to consolidate.

(7) Prepare a sample of commercial stearin, heating it four minutes. This will consolidate in about half an hour or less, at the temperature given above.

Some samples of compound lard are very deceptive in appearance, being smooth and translucent, especially such as are composed of lard and oleo, but these are easily detected by the use of the microscope and polarized light. My usual practice is, first, to examine each sample with the unaided eye, compressing a portion of the lard about the size of a large pin-head between two pieces of clear glass about one inch square each, and holding each sample up to the light to compare it with a sample of home-rendered lard similarly prepared. As fictitious lard contains a large amount of stearin, it will exhibit by this method of examination many white spots, which represent the crystallized stearin, and which are not seen in pure lard. The amount of natural stearin in pure lard is so small that it is not visible to the unaided eye by this method of examination; therefore the microscope should be used in the examination of pure lard, as the groupings of the crystallized fats of

PLATE I.



PURE LARD AND FICTITIOUS LARD.

lard are very small. These groupings are in stellar forms, composed of spicules which proceed from a common center, frequently requiring to be magnified 400 times to discern, while the groupings of branched crystals of stearin are easily observed to advantage under a power of 100 diameters.

Stearin constitutes one of the principal fats of fictitious lard. It gives firmness to the other fats and is less soluble than palmitin. It is the first to crystallize when held in solution with other fats. Its branched groupings are easily resolvable under the microscope, and always appear very bright by polarized light. Taking advantage of these facts I heat, say, 4 ounces of a suspected lard in any suitable vessel, over the flame of a Bunsen burner. If the sample hardens quickly in a temperature of about 75° F., it will be found to contain a large amount of stearin. A sample, on the other hand, consisting principally of either pure lard or oleo, or of a mixture of these two, will consolidate very slowly as compared with a sample to which a large proportion of commercial stearin has been added. The first fumes which arise in the heating process will indicate somewhat the composition of the fat. If it contains a large amount of leaf or other lard, the lard odor will be easily recognized. If the sample contains only a trace of lard, the lard odor will be evanescent. If very acrid fumes arise during the heating process, producing a tendency to cough on the part of the observer, the presence of cotton-seed oil is indicated.

The two commercial solid fats which enter largely into compound lard, as at present manufactured, are commercial stearin and oleo, to which is generally added cotton-seed oil for the purpose of reducing the stearin to the consistency of pure home-rendered lard.

Explanation of Plate I.

Plate I represents the various crystalline forms of pure leaf lard, lard compounds, and of compound fats sold as lard.

Figs. 1, 2, and 8. Crystalline forms of pure leaf lard.
Fig. 3. A compound of stearin, oleo, and cotton-seed oil.
Fig. 4. A compound of lard and oleo.
Fig. 5. Stearin, oleo, and cotton-seed oil.
Fig. 6. Stearin, cotton-seed oil, and a trace of palmitin.
Fig. 7. Stearin, oleo, and cotton-seed oil.

Samples 3, 5, 6, and 7 are varied in their proportions of stearin, oleo, and cotton-seed oil. When stearin is in excess in one of these compounds it appears in very bright, branching crystals in the center of each mass of crystallized palmitin. All fictitious lards abound in stearin. On being highly heated, and cooled slowly in a temperature of about 75°, the stearin, by reason of being less soluble than the palmitin fat, crystallizes first; following this, the palmitin crystallizes over the branching stearin crystals.

Viewed under polarized light with dark ground, the composition of the respective fats, stearin and palmitin, are at once distinguished one from the other. The cotton-seed oil, although a fat, is not observed under the microscope, as it does not crystallize at ordinary temperatures.

Pure lard, unless highly heated, exhibits a dull crystalline appearance as compared with stearin, because it consists mostly of palmitin and oil, with but a trace of stearin.

ADULTERATED COFFEE.

Several samples of imitation coffee have been sent to this division by citizens of this city for examination and report. This coffee imitates the color and form of the natural beans, and at first sight would readily deceive. My examination of the samples clearly shows the character of the substance used in its manufacture. Scraping off a small quantity of the bean and dissolving it on a glass slide, in a drop of water, I

examined the substance under the microscope with polarized light. I found that it consisted of dextrine made from potato starch. The starch granules were very much swollen, owing to the high temperature to which the starch had been subjected to convert it into dextrine.

Dextrine is a substance used largely instead of flour as a paste, and may be purchased wholesale at 4 cents per pound. It may be made from flour or from any starch. The granules of potato starch are easily distinguished from all others by their large size and peculiar form. They are polarizing bodies, and therefore show the prismatic colors when viewed with Nicol prisms.

To detect the spurious bean it is only necessary to throw a handful of them into hot water. If made of dextrine they will dissolve, while the natural coffee bean will retain its form.

FOUR EDIBLE MUSHROOMS OF THE UNITED STATES.

In my former publications relating to poisonous and edible mushrooms I have endeavored to make my description of species agree as nearly as possible with the common names in use in all English-speaking countries, giving at the same time their scientific names. It is acknowledged by all mycologists who have devoted much time to the study of mushrooms, edible or poisonous, that in order to obtain a knowledge of them it is necessary to study closely their respective structural forms and the color of their spores, gills, etc. Botanically considered, a glossary of terms is required for the beginner, and without one it would be difficult for the student to make much progress. Such a glossary has been added to this paper, and also a plate of sectional drawings showing at once the diverse forms of the cap, gills, and of the stalk. The requests of many correspondents leave no room to doubt that both glossary and plate will be appreciated.

It has also been deemed advisable to furnish for this report full-sized drawings, colored after nature and given in detail, so as to enable those possessed of botanical skill to distinguish the more readily one species from another.

In the Annual Report of this Department for the year 1885 was published my first paper, "Twelve edible mushrooms of the United States." This paper appeared to attract but little attention until several years after its publication, when a number of letters were received from various States and Territories of the United States asking for separate copies of the report. Ultimately, when the supply of this report had been exhausted, a new edition of the paper was issued, illustrated, and retaining the original title, "Twelve edible mushrooms of the United States." This was followed by a second illustrated paper entitled "Eight edible and twelve poisonous mushrooms of the United States," which first appeared in the annual report of the Division of Microscopy for 1890. The demand for copies of one or both of these two papers has greatly increased, requests having come in from all parts of the United States and from Canada, and from all classes of our people, affording evidence of a widespread interest in this subject, either from an economic standpoint or technically as a matter of plant study. Applications for these reports have been received also from various agricultural experiment stations. There is also a continued demand for more information on the cultivation of the well-known species *Agaricus campestris* and *A. arvensis*, the common meadow mushroom.

The successful cultivation of mushrooms on a large scale is carried

on extensively in many places throughout Europe and in Great Britain. Mr. John F. Barter, of London, England, who is considered the largest mushroom-grower in Great Britain, wrote to a friend in the United States that he marketed during the season of 1889–'90 11 tons of mushrooms, and during the season of 1890–'91 about 10 tons. In a meritorious treatise on "Mushroom culture for pleasure and profit," by Mr. William Falconer, of New Jersey, the author remarks:

In the most prosperous and progressive of all countries, with a population of nearly seventy millions of people alert to every profitable legitimate business, mushroom growing, one of the simplest and most remunerative of industries, is almost unknown. Mushrooms and their extensive and profitable culture should concern every one.

For home consumption they are a healthful and grateful food, and when successfully grown for market they become a most profitable crop. No one can grow mushrooms better nor more economically than the farmer. He has already the cellar room, the fresh manure, and the loam, and all he needs is some spawn with which to plant the beds. Nothing is lost. The manure, after having been used in mushroom-beds, is not exhausted of its fertility, but instead is well rotted and in a better condition to apply to the land than it was before being used for the mushroom crop. The farmer will not feel the little labor it takes. There is no secret whatever connected with it, and skilled labor is unnecessary to make it successful. The commonest farm hand can do the work, which consists of turning the manure once every day or two for about three weeks and then building it into a bed and spawning and covering it with mold. Nearly all the labor for the next ten or twelve weeks consists in maintaining an even temperature and gathering and marketing the crop.

Many women are searching for remunerative and pleasant employment on the farm, and what can be more interesting, pleasant, and profitable work for them than mushroom-growing. After the farmer makes up the mushroom bed, his wife or daughter can attend to its management with scarcely any tax upon her time and without interfering with her other domestic duties. And it is clean work; there is nothing menial about it. No lady in the land would hesitate to pick the mushrooms in the open field; how much less, then, should she hesitate to gather the fresh mushrooms from the clean beds in her own clean cellar. Mushrooms are a winter crop; they come when we need them most. The supply of eggs in the winter season is limited enough and pin-money often proportionately short; but with an insatiable market demand for mushrooms all winter long at good prices, no farmer's wife need care whether the hens lay eggs at Christmas or not. When mushroom-growing is intelligently conducted there is more money in it than in hens, and with less trouble.

MUSHROOM CULTURE.

The cellar of a dwelling house is a capital place for mushroom beds, and can be used in whole or in part for this purpose. In the case of private families who wish to grow only a few mushrooms for their own use it is not necessary to use the whole cellar; it will be sufficient to partition off a part of it with boards and make the beds in this, or to make a bed alongside of the wall anywhere and box it in to protect it from cold drafts and from mice and rats. Shelves may be placed above the bed for domestic purposes, just as in any other part of the cellar. Bear in mind that mushrooms thrive best in an atmospheric temperature of from 50° to 60°, and if you can give them this in your house cellar you ought to get plenty of good mushrooms. But if such a high temperature can not be maintained without impairing the usefulness of the cellar for other purposes, box up the bed tightly and from the heat of the bed itself when thus confined there usually will be warmth enough for the mushrooms, but if there is not, spread a piece of old carpet or matting over the boxing.

The beds may be made upon the floor, and flat or ridged or banked against the wall 10 or 12 inches deep in a warm cellar, and 15 to 20 inches or more deep in a cool cellar, and about 3 feet wide and any length to suit. The boxing may consist of any kind of boards for sides and ends, and be built about 6 or 10 inches higher than the top of the beds, so as to give the mushrooms plenty of head room. The top of the boxing may be a lid hung on hinges or straps, or otherwise arranged to admit of being easily raised or removed at will, and made of light lumber, say of half-inch boards. In this way, by opening the lid the mushrooms are under observation and can be gathered without any trouble. When the lid is shut they are secure from cold and vermin. Thus protected, the cellars can be ventilated without interfering with the welfare of the mushrooms. A light wooden frame covered with calico or oiled paper would also make a good top for the boxing, but would not be proof against much cold or against rats or mice. If desirable, shelf beds could be built in warm cellars above the floor beds, but in cool airy cellars this would not be advisable.

Manure beds in the dwelling-house cellar may seem highly improper to many people, but when rightly handled these beds emit no bad odor. The manure should be prepared away from the house, and when ready for making into beds should be spread out thin, so as to become perfectly cool and free from steam. When it has lain for two days in this condition it may be brought into the cellar and made into beds. Having been well sweetened by previous preparation, it is now cool and free from steam, and almost odorless. After a few days it will warm up a little, and may then be spawned and earthed over at once. Do not bury the spawn in the manure; merely set it in the surface of the manure. This method prevents the spawn from being destroyed by too great heat, should the bed become unduly warm. If the manure has been well prepared, however, this is not likely to occur. The coating of loam prevents the escape of any further steam or odor from the manure.

On the 14th of January last Mr. W. Robinson, editor of the London Garden, in writing to me mentioned the following very interesting case of growing mushrooms in the cellar of a dwelling house:

I went out the other day to see Mr. Horace Cox, the manager of the Field newspaper, who lives at Harrow, near the famous school. His house is heated by a hot-water system called Keith's, and the boiler, which is a very simple one, is in a chamber of the house in the basement. I went down to see it worked with coke refuse. However, I was pleased to see all the floor of the room not occupied by the boiler covered with little flat mushroom-beds and bearing a very good crop. Truth to tell, I used to fear that growing mushrooms in dwelling houses might be objectionable in various ways, but this instance is very interesting, as there is not even the slightest unpleasant smell in the chamber itself. The beds are small, scarcely a foot high, and perfectly odorless, so that it is quite clear that one may cultivate mushrooms in one's house in such a case as this without the slightest offense. A bed has been known to begin bearing early in November and to bear a good crop until the first of May. Mr. Denton, a market gardener about 10 miles from New York on Long Island, uses both French and brick spawn. He markets from 1,700 to 2,500 pounds of mushrooms a year from his two cellars. Every summer he cleans out his cellars and lime-washes them all over. He ascribes his success to thorough cleaning.

GLOSSARY OF TERMS USED IN DESCRIBING MUSHROOMS.

Acaulescent, with a very short stem, apparently none.
Acetabuliform, shaped like a cup.
Adnate, gills firmly attached to the stem.
Adnexed, gills just reaching the stem.
Alveolate, socketed or honeycombed.
Amphigenous, when the hymenium is not restricted to a particular surface.
Anastomose, the joining of one vein with another; branching.
Annular, having the form of a ring.
Annulate, ringed, or with the appearance of a ring.
Annulus, ring, round the stem of Agarics.
Arachnoid, cobweb-like in structure or appearance.
Asci, spore-cases.
Ascending, directed upwards.
Ascidia, spore-cases of certain fungi.
Attenuate, tapering gradually to a point, upward or downward.
Basidia, cellular processes of certain mushroom-bearing spores.
Bossed, furnished with a boss. (*See also* Umbonate.)
Bulbous, with the structure of a bulb.
Cæspitose, growing in tufts.
Campanulate, bell-shaped.
Canaliculate, channeled.
Cap, the pileus of a mushroom.
Capillitium, threads of puff-balls.
Carious, decayed.
Cartilaginous, hard and tough.
Channeled, hollowed out like a gutter.
Chlorosis, loss of color.
Cilia, marginal hair-like processes.
Ciliate, fringed with hair-like processes.
Clathrate, latticed.
Clavate, gradually thickened upwards.
Club-shaped. (*See* Clavate.)
Cortinate, cobweb-like in texture.
Connate, as when two or more pilei become united.
Cratera, a cup-shaped receptacle.
Crenulate, notched or scalloped.
Cryptogamia, a term applied to the division of nonflowering plants.
Decurrent, when the gills of an Agaric are prolonged down the stem.
Dentate, toothed.
Distant, applied to the gills of Agarics when far away from each other.
Dimidiate, applied to the gills of Agarics when they proceed only half way to the stem.
Echinate, furnished with stiff prickles.
Emarginate, applied to the gills when they are notched or scooped out before reaching the stem.
Excentric, out of center.
Farinose, covered with a white mealy powder.
Favose, honeycombed.
Fibrillose, covered with loose fibers.

Fimbriated, fringed.
Fistular, Fistulose, tubular, closed at each end in the case of mushrooms.
Flexuose, wavy.
Floccose, covered with hairs which fall away in tufts.
Foveolate, pitted.
Free, not adhering nor adnate; used in relation to the gills of mushrooms.
Fructification, reproductive parts of a plant.
Fugaceous, falling off rapidly.
Funnel-shaped. (*See* Infundibuliforme.)
Gills, vertical plates radiating from the stipe on the under surface of the pileus of mushrooms.
Glabrous, smooth.
Globose, nearly spherical.
Habitat, natural abode of a plant.
Hirsute, hairy.
Hymenium, the part of mushrooms on which spores are borne; the fructifying surface.
Hymenophorum, the structure which bears the hymenium.
Hypogæous, subterranean.
Hygrophanous, looking watery when moist and opaque when dry.
Imbricate, overlapped like tiles.
Infundibuliforme, funnel-shaped.
Inferior, growing below, as when one organ grows below another.
Involute, with the edges rolled inwards.
Lacunose, pitted or having cavities.
Lamellæ, the gills of mushrooms.
Lepiota (from the Greek word meaning *a scale*), the annulus of some fungi.
Lateral, attached to the side.
Linguiform, shaped like a tongue.
Marginate, having an edge of a different texture to the body, so as to form a distinct border.
Matrix, any body upon which a fungus grows.
Mycelium, the spawn of fungi.
Netted, covered with projecting reticulated lines.
Obtuse, blunt or rounded.
Pallid, a pale and undecided color.
Paraphyses, jointed threads found with the reproductive organs of some plants.
Papillose, covered with soft tubercles.
Parasitic, growing on and deriving support from another plant.
Pedicel, foot-stock.
Pedicellate, having a pedicel.
Pectinate, toothed like a comb.
Peridium, general covering of a puff-ball.
Pilcate, having a cap or pileus.
Pileus, the cap of a mushroom.
Pilose, hairy.
Pits, depressions in cells or tubes resembling pores.
Plumose, feathery.
Powdery, covered with bloom or powder.
Pubescent, downy.
Pulverulent, covered with dust.
Pulvinate, like a cushion.
Remote, when the margin of the gill comes to an end before reaching the stem.
Rugose, covered with wrinkled lines, the interspaces being convex.
Resupinate, inverted by twisting of the stalk.
Scabrous, rough.
Scrobiculate, marked with little pits or depressions.
Semi, half.
Serrate, toothed like a saw.
Sessile, without a stalk.
Sinuate, with a waved margin.
Species, a group of individuals without deviation from each other, except such as might result from accidental circumstances.
Spheroidal, nearly spherical.
Spores, the reproductive bodies of cryptogams analogous to seeds.
Sporidia, reproductive cells.
Sporophores, cells surmounted by fertile spicules.
Squamose, scale-like, scaly.
Squarrose, rough, with projecting or deflexed scales.
Stem, the ascending axis of plants.
Stigmata, points of the basidia of some mushrooms.
Stipe, stem of mushrooms.
Striated, streaked with longitudinal lines.
Strigose, covered with sharp rigid hairs.
Stuffed, filled with a spongy mass; applied to stems of mushrooms.
Sulcate, furrowed.
Tomentose, downy with short hairs.
Torsive, twisted spirally.
Torulose, when a cylindrical body is swollen and restricted alternately.
Trama, the substance intermediate between the hymenium in the gills of Agarics or pores of Polyporei.
Tremelloid, jelly-like in substance.
Tubular, hollow and cylindrical.
Turbinate, top-shaped.
Umbonate, furnished with a boss.
Umbo, a central elevation like the boss of an ancient buckler.
Umbilicate, having a central depression.
Veil, in mushrooms, partial covering of the stem or margin of the cap.
Verrucæ, warts or glandular elevations.
Verrucose, covered with warts.
Villose, covered with long weak hairs or down.
Volute, rolled up in any direction.
Volva, a general wrapper in mushrooms, sometimes membranous, sometimes gelatinous.
Wart, a firm glandular excrescence on the surface. (*See* Verrucæ).

EXPLANATION OF PLATES.

PLATE II.—AGARICUS MELLEUS, Vahl. (Order *Agaricini.*)

(Edible.)

Subgenus ARMILLARIA (Little Bracelet). Veil partial, annular, hence the name from armilla, an armlet or bracelet, alluding to the ample persistent collar of the plant. Described by Bulliard as *Agaricus annularis*, by Decandolle as *A. annularius*, by Persoon as *A. polymyces*.

Cap fleshy, honey-colored or ocherous, striated on the margin, shaded with brown, darker towards the center, umbonate or umbilicate in full-grown specimens, tufted with dark-brown fugitive hairs. Color of cap varies, depending upon climatic conditions and the character of the soil. Gills distant, ending in a decurrent tooth, pallid or dirty white, very often showing brown or rust-colored spots when old. Spores white and abundant. Stem elastic, scaly, 4 inches or more in length. Ring floccose. Diameter of cap from 2 to 5 inches. Manner of growth cæspitose, and, as with most of the Armillarias, generally parasitic on old stumps, although I found the group here figured growing on moist sandy clay on a roadside in Hyndsbury Park, Md.

PLATE III.—AGARICUS DELICIOSUS, Fr.

(Edible.)

Subgenus LACTARIUS (milk-bearing). Hence the name, from *lac*, milk, applied to the exudation from the gills, which in some of the species resembles cows' milk. Deliciosus refers to the agreeable flavor of the plant, which is one of the most remarkable of this group.

Cap fleshy, hemispherical, then convex umbilicate in some adult specimens, funnel-shaped, marked in the adult plant with rings or zones of a ferruginous color. Color of the cap orange, varying in tint, growing paler and greenish when old or dried. Diameter from 2 to 6 inches. Gills decurrent, crowded, rather thick, sometimes slightly forked at the base, according to some French writers on mushrooms. Color of the gills pale orange, sometimes a saffron yellow, exuding when bruised a bright red or orange colored liquid, hence often given the name, popularly, of the "orange-milk" mushroom. This liquid turns green on exposure to the atmosphere. Stem attenuated downward, smooth, and stuffed with a yellowish pith, then hollow, and finally brittle. Color about the same as the cap.

PLATE IV.—CANTHARELLUS CIBARIUS, Fr.

(Edible.)

This species is distinguished from an Agaric, which at first sight it resembles, by having veins instead of gills. It has been described by Linnæus as *Agaricus cantharellus*, by Bulliard under the same name, by Scopoli as *Merulius cantharellus*. Fries does not put it in the list of Agaricini, while Berkeley classifies it under that order. The chantarelle takes its name from a Greek word signifying a cup or vase, referring to its shape and possibly also to its rich golden color. Cibarius refers to its esculent properties.

Cap a rich egg yellow, at first convex, later concave and turbinated. Margin sinuous-undulate, smooth and more extended on one side than the other. Diameter nearly 4 inches. Veins rather thick and wiry, markedly decurrent, usually bifurcated 2 or 3 times, and of the same color as the cap. Spores white. Stem stuffed, thicker above, tapering downward, and slightly curved at the base. Flesh white and firm, odor agreeable, flavor a little peppery. Found in the woods in groups in summer and in autumn.

PLATE V.—FISTULINA HEPATICA, Fr. (Order Polyporei.)

(Edible.)

Fistulina refers to the form of its little tubes situated on the under surface of this mushroom, *hepatica* to its fancied resemblance when old to a piece of liver. It is also called by the French, Langue de Bœuf, beef's tongue, which it sometimes resembles, when young, in shape and color.

Cap of variable form, upper surface at first, blood-red, covered with papillæ, then

AGARICUS (ARMILLARIA) MELLEUS.
Group from Hynesboro Park, Md., U.S.

K. MAYO, del.

Sackett & Wilhelms Lithographing Co. New York.

AGARICUS (LACTARIOUS) DELICIOSUS.
1 General form. 2 Section. 3 Spores.

L. KRIEGER del.

Sackett & Wilhelms Lithographing Co. New York.

CANTHARELLUS CIBARIUS FR.
1, 2, 3, 4, Various stages of growth 5 A section.
6 Spores 7 Spores and basidia.
From Hynesbury, Md., U.S.

K. MAYO, del.

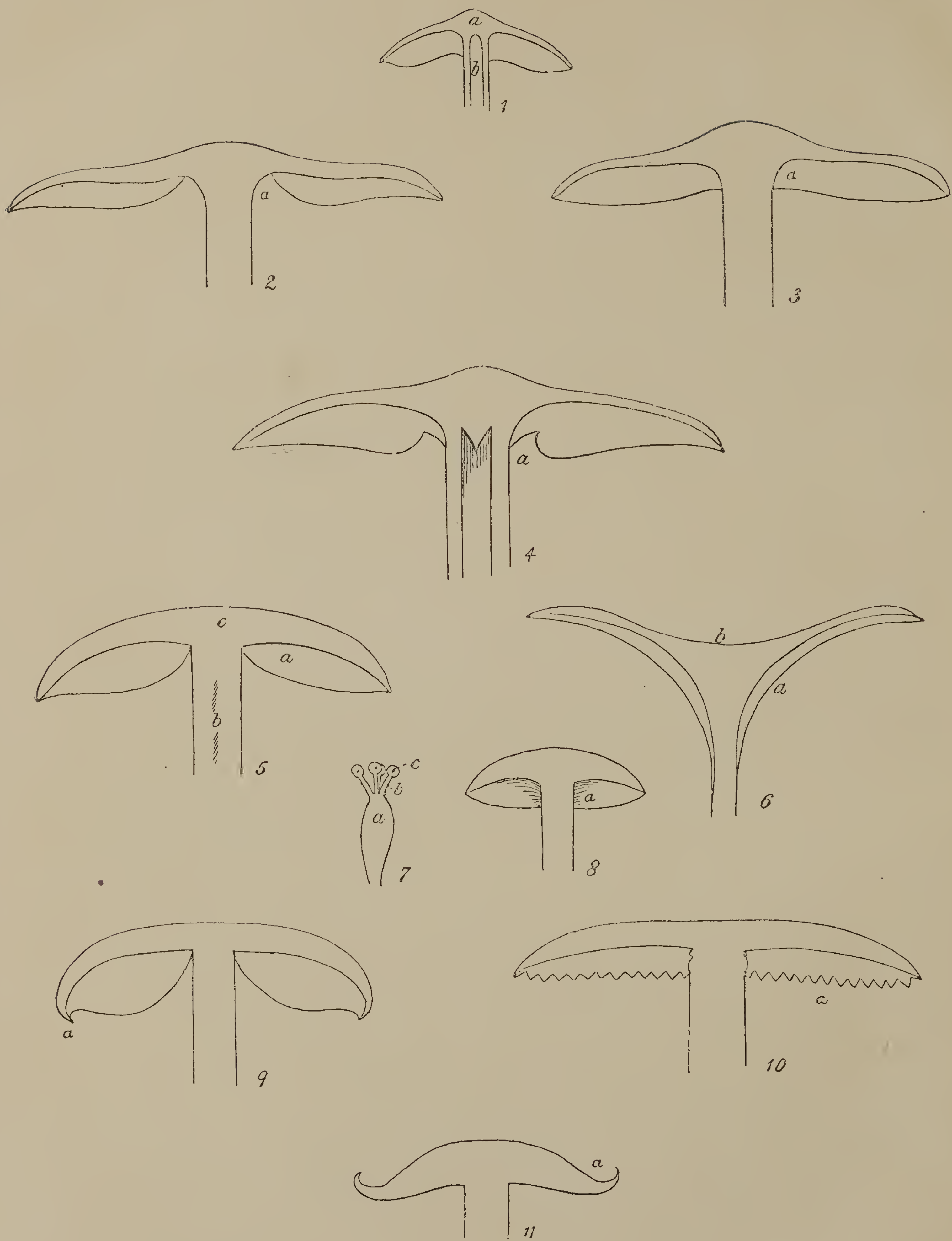
Sackett & Wilhelms Lithographing Co New York

FISTULINA HEPATICA.

1 Specimen, upper view. 2 Same, under view.
3 Specimen, upper view. 4 Same, under view.
5 Spores.

K. MAYO, del.

Sackett & Wilhelms Lithographing Co. New York



SECTIONS OF MUSHROOMS.

W. Scholl. del.

red-brown, and finally a very dark red. Flesh fibrous, juicy, and mottled. Flavor acid, odor agreeable. Tubes at first short, then elongated, having fringed orifices, color whitish, turning brown when bruised. Sometimes found of quite large size. One is mentioned as found in England weighing 30 pounds. Found in summer and autumn on oak and beech trees principally. In Italy its common name is said to be "oak tongue" or "chestnut tongue," and it is said to be equally good whether gathered from one or the other.

This mushroom is described by Schaeffer as *Boletus hepaticus;* Bulliard gives it as *Fistulina buglossoides.* Berkeley describes a "beautiful and interesting species, *A. (Pleurotus) subpalmatus,* Fr.," as having the flesh mottled like that of *Fistulina hepatica,* and also gives the habitat of *Polyporus quercinus* as identical with the species represented in Plate V. Figs. 1, 2, 3, and 4 of this plate represent the color and form of the upper and under surfaces of specimens collected near Falls Church, Va., where the species grows in profusion.

For most beautiful specimens of this and many other of our native mushrooms, I am indebted to Dr. F. J. Braendle, Falls Church, Va.

PLATE VI.—STRUCTURE OF THE GILL-BEARING MUSHROOMS.

Fig. 1. Cap or pileus umbonate, *a*; stem or stipe fistulose, *b*; gills or lamellæ adnate and slightly emarginate.
Fig. 2. Gills remote, *i. e.,* distant from the stem. (See *a.*)
Fig. 3. Gills adnexed, partly attached to the stem at their inner extremity *a.*
Fig. 4. Gills emarginate, with a tooth, as at *a,* stem stuffed.
Fig. 5. Cap obtuse, *c*; gills free, *i. e.,* reaching the stem but not attached thereto. (See *a.*) *b,* stem, stuffed.
Fig. 6. Cap umbilicate, *b*; gills decurrent, *i. e.,* running down the stem. (See *a.*)
Fig. 7. Basidium cell, *a,* borne on the hymenium or spore-bearing surface of the gills; *b,* stigmata; *c,* spores.
Fig. 8. Gills adnate, *i. e.,* firmly attached to the stem at their inner extremity, as at *a.*
Fig. 9. Cap with border involute, *i. e.,* rolled inward. (See *a.*)
Fig. 10. Lamellæ or gills dentated or toothed. (See *a.*)
Fig. 11. Cap with border revolute, *i. e.,* rolled backward. (See *a.*)

MECHANICAL DEVICES PERFECTED DURING THE YEAR.

REVOLVING STAGE FOR VIEWING MICROSCOPIC SECTIONS, ETC.

[Plate VII.]

This plate exhibits a view of a new and improved form of revolving brass plate which I have recently devised in order to supply a need long felt in the division. It may be attached to any microscope, and is designed principally for reviewing and comparing serial sections and textile fibers. This revolving plate is pivoted upon the substage by means of a downward-projecting pin. It may thus be rotated freely at the pleasure of the operator. Slides mounted with subjects for investigation and comparison are secured by means of spring clips upon the surface of the plate.

A stage of this description which I am accustomed to use exhibits eleven different samples of wools. In jury trials relating to wools I have found it sometimes desirable to have six microscopes in use at one time in illustrating the respective characteristics of various samples of wool. Even with this number the parties are seldom satisfied, as one person is obliged to move from one instrument to another, interfering perhaps with the view of other observers. The system I have initiated saves much time—an important consideration in the court room. By means of the revolving plate, eleven diverse samples may be compared in less time than an observer could move from one microscope to another.

Six stands of this model were on exhibition at the fourteenth annual meeting of the American Microscopical Society, recently held in this city,

and the invention gave universal satisfaction. The publishing committee of the society have requested a description of this plate for the forthcoming volume of proceedings.

I use a similar form for high powers, consisting of perfectly clear glass 2 millimeters in thickness, circular in form like the preceding, and, like it, attachable to the plane stage of a microscope. On this plate the objects may be arranged upon its margin, the same as on the usual glass slides, and the cover-glass fixed upon them, thus dispensing with clips, which interfere somewhat with the objective when using high powers. Or the plate may be perforated, as in the metal plate, the mounts fixed by means of wax or a drop of paraffine at the edges of the slides. This method, I find, renders the object sufficiently steady for examination, and the wax has the advantage of being easily removed when it has answered the purpose, leaving a clean plate for change of subject or for further investigation. The diameter of the revolving plate is only limited by the construction of the microscope stand, to which it is an adjunct.

MACHINE FOR TESTING THE TENSILE STRENGTH OF VEGETABLE FIBERS AND THREAD.

[Plate VIII.]

Plate VIII, Fig. 1, represents the Taylor Machine No. 1 for testing the tensile strength of textile fibers, such as flax, cotton, ramie, silk, etc., used in the manufacture of the various threads.

In applying this machine, one end or thread to be tested is secured by means of wax* to the small brass knob *b* of spring *a*. The other end of the fiber or thread is secured to a similar brass knob *c* attached to the rod *d*, to which a rectilinear motion is communicated by means of a screw *e* and wheel *f*, corresponding to the plane of the spring and the fiber. On revolving the wheel the thread is stretched until it breaks; *g* is a scale underneath the fiber or thread between the points of connection of the thread with the spring and rod. Fig. 2 is a full-size view of this scale; *h* represents a metal block which is moved forward on the scale by means of a drive pin attached to the spring and projecting downward from it. When the thread breaks, the block *h* remains stationary at the point to which it has been moved forward with the stretch, indicating on the scale the breaking strain in pounds or fractions thereof to which the fiber or thread has been subjected. Scale *i*, shown on the semicircular plate, over which an index is mechanically moved as the wheel revolves, registers in a higher degree the tension to which the thread has been subjected before breakage. A is a device for ascertaining the weight value of the spring used in the machine, which should be always ascertained in advance and the spring then placed in position in the machine, as above. The spring suspended, as represented at A, is weighted to any amount desired, and its extension, corresponding to such weight, will be registered on the graduated scale *g'*, which corresponds with scale *g* of the machine already described.

The subjoined table gives the results of eighty preliminary tests on this machine of four samples of foreign flax thread, *i. e.*, Courtrai, Dutch, Irish, and Russian, twenty tests of each having been made separately.

* In testing the tensile strength of fibers it is found in practice that the respective ends of the fiber or thread should be secured by twisting each end several times round a knob, painted with a composition of beeswax, instead of securing the ends with a knot, since a thread has a great tendency to break at a knot.

These samples were in separate parcels, each marked with the market value of the fiber per ton: Courtrai, $367.84; Dutch, $306.60; Irish, $266.20; Russian, $193.60.

Fiber.	Size of thread.	Minimum breaking strain.	Maximum breaking strain.	Average.	Total of 20 fibers.
		Pounds.	*Pounds.*	*Pounds.*	
Courtrai	40s	1.375	3.6666	2.7797	55.540
Dutch	40s	1.375	3.2083	2.2229	44.458
Irish	40s	1.375	3.6666	2.0277	40.454
Russian	40s	1.604	2.9792	1.9937	39.874

Second experiment.

Fiber.	Minimum breaking strain.	Maximum breaking strain.	Average.
	Pounds.	*Pounds.*	*Pounds.*
"50 line." (This is the product of 70 pounds of dressed flax, giving 60 pounds of linen yarn, which, spun as per sample, will measure 940,000 yards.)	1.459	2.0625	1.5927
"25 tow." (The product of 27 pounds of tow, giving 22 pounds of this yarn, which, spun to this sample, will measure 165,000 yards.)	1.4896	5.2708	2.3949

NOTE.—Both these samples, "50 line" and "25 tow," were produced from 100 pounds of raw flax, on which there was a loss in the process of manufacture of 3 pounds. "Line" means a thread or yarn which has been spun from dressed flax only, in contradistinction to "tow" yarns, which are made from tow alone.

"40s" is used to designate the size of the thread, and means that in 1 pound weight of that yarn there are 40 leas or cuts, each lea or cut containing 120 threads of 2½ yards each, so that 1 pound of 40s yarn should contain 40 leas, giving 4,800 threads, equal to 12,000 yards in all. "50 line," on the other hand, would give to 1 pound of yarn 50 leas, equal to 6,000 threads, or 15,000 yards. "25 tow" will give to 1 pound weight 25 leas, equal to 3,000 threads, or 7,500 yards, and other numbers in proportion. In the second experiment here given the tests were made, probably, from samples containing a mixture of each of the different classes of raw flax, this being a method of manufacture frequently adopted by spinners in order to obtain the best results for a certain price.

The London prices during December for yarns spun from the different classes of flax mentioned in the table were as follows:

Per 60,000 yards.

	s	*d.*
Courtrai	4	11
Dutch	4	8
Irish	4	6
Russian	4	5

It will be noticed how closely these prices coincide with the relative strength value of the fibers, as determined by the tests. While the flexibility, evenness, and superior brilliancy of some flaxes commend them for special purposes, it is evident that for the farmers' uses, for binder twine, cordage, etc., the tensile strength of the fiber constitutes its greatest commercial value and is the most important object of investigation.

MACHINE FOR TESTING BINDER TWINE.

(Plate IX.)

By the use of this machine (Taylor machine No. 2), farmers' binder twine or small cord may be tested quickly, and the relative strength of samples of either ascertained.

The groundwork of the machine consists of iron and steel, of which

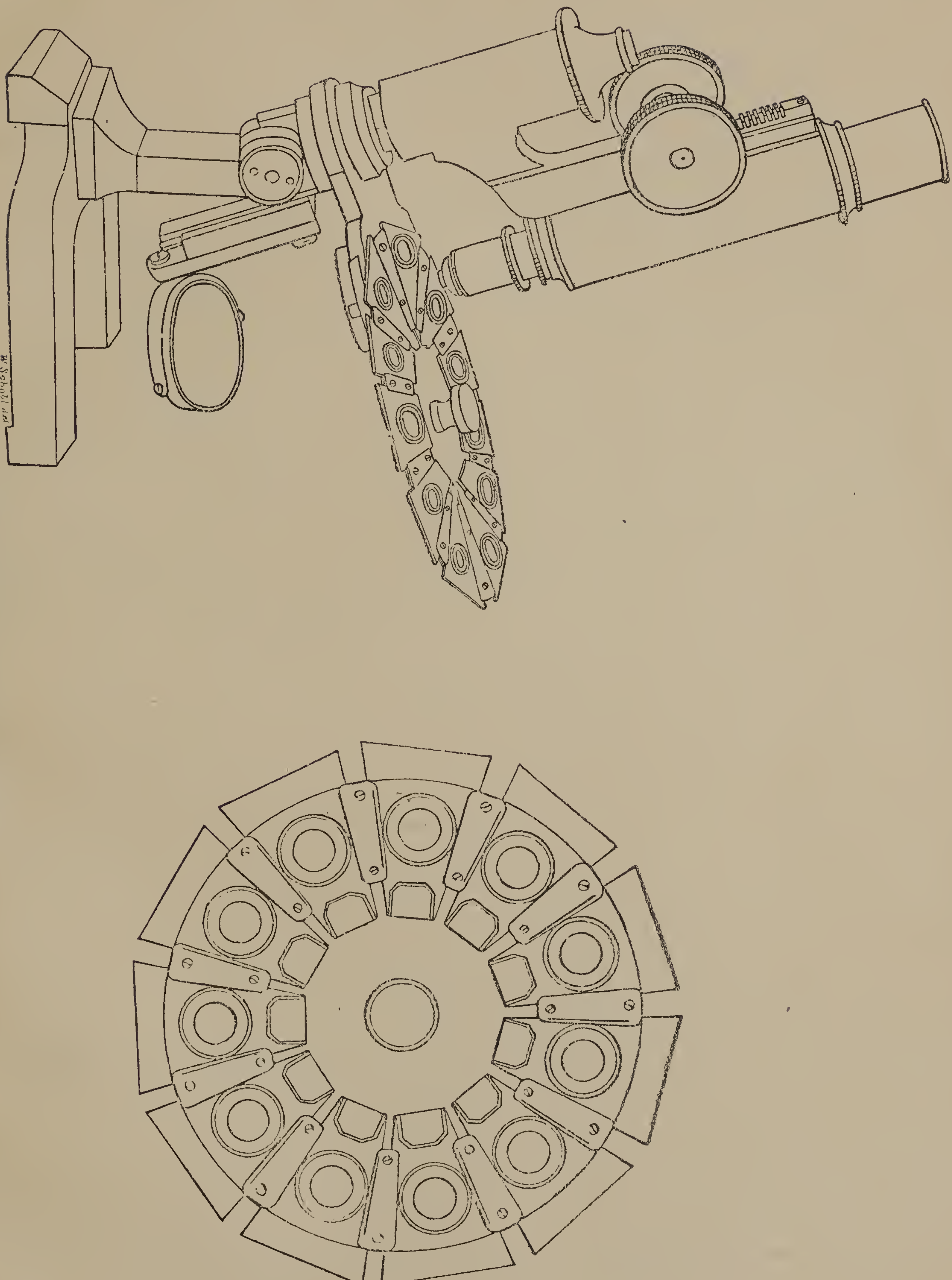
Plate IX, Fig. 1, illustrates a top view; *a a*, bed of the machine; A, Fig. 2, section of *a a; h h*, slide-bearings on surface of the machine bed; *b*, operating wheel of screw *c; d* and *e*, journal-boxes, both stationary. The screw *c* passes through a movable framework consisting of *g g'* and connecting rods *f f; i*, a collar on shaft of screw *c* in box *e; g g* is the only journal-box furnished with a screw thread, consequently on the revolution of the screw the frame *g g' f* is set in motion, since the screw has no lateral motion.

To operate the machine, turn the screw until box *g g* touches stationary box *e*. One end of the cord or twine to be tested is passed through the opening at *w*, to *t*, where it is twisted over pins on top of *g g'*. The other end of the cord or twine is passed through a moveable frame *u*, and secured in position at *m*. A steel spring *o*, 5 inches in diameter, supported by an iron cylinder, passes through a rubber spring *q*, or its equivalent, and is secured by nut *v; n* and *q* are springs which receive the recoil of the large spring *o* when the cord breaks. Countersunk in slide-bearing *h* is a stationary scale *y*, and over it a movable scale-bar *j*. On frame *u*, at *z*, is a projection for the purpose of pushing to the left the scale bar *j*, which uncovers scale *y* as the screw is rotated to the right. On the cord being stretched, an index *s*, secured on a movable rod *s'*, which in turn is secured to frame *g'*, and movable with it, registers the stretch, up to the breaking point, in inches and fractions thereof. Scale *y* comes into view in proportion to the movement of the scale bar *j* to the left. As the end of scale bar *j* resting on scale *y* is filed to a thin edge, it becomes the index of scale *y*, showing the breaking strain in pounds and fractions thereof.

The subjoined table gives the results of a given number of preliminary tests by this machine of a sample of farmers' binder cord of Manilla hemp.

Tests of a sample of farmers' "binder twine" made of Manilla hemp.

No. of test.	Breaking strain.	Stretch.	No. of test.	Breaking strain.	Stretch.
	Pounds.	*Inches.*		*Pounds.*	*Inches.*
1	72.5	1.6875	9	55	1.375
2	40	1.5	10	60	1.375
3	75	1.375	11	80	1.625
4	60	1.25	12	70	1.25
5	100	1.625	13	80	1.5
6	50	1.75	14	55	1.25
7	75	1.25			
8	55	1.25	Average	66.25	1.433



MICROSCOPE WITH REVOLVING STAGE.

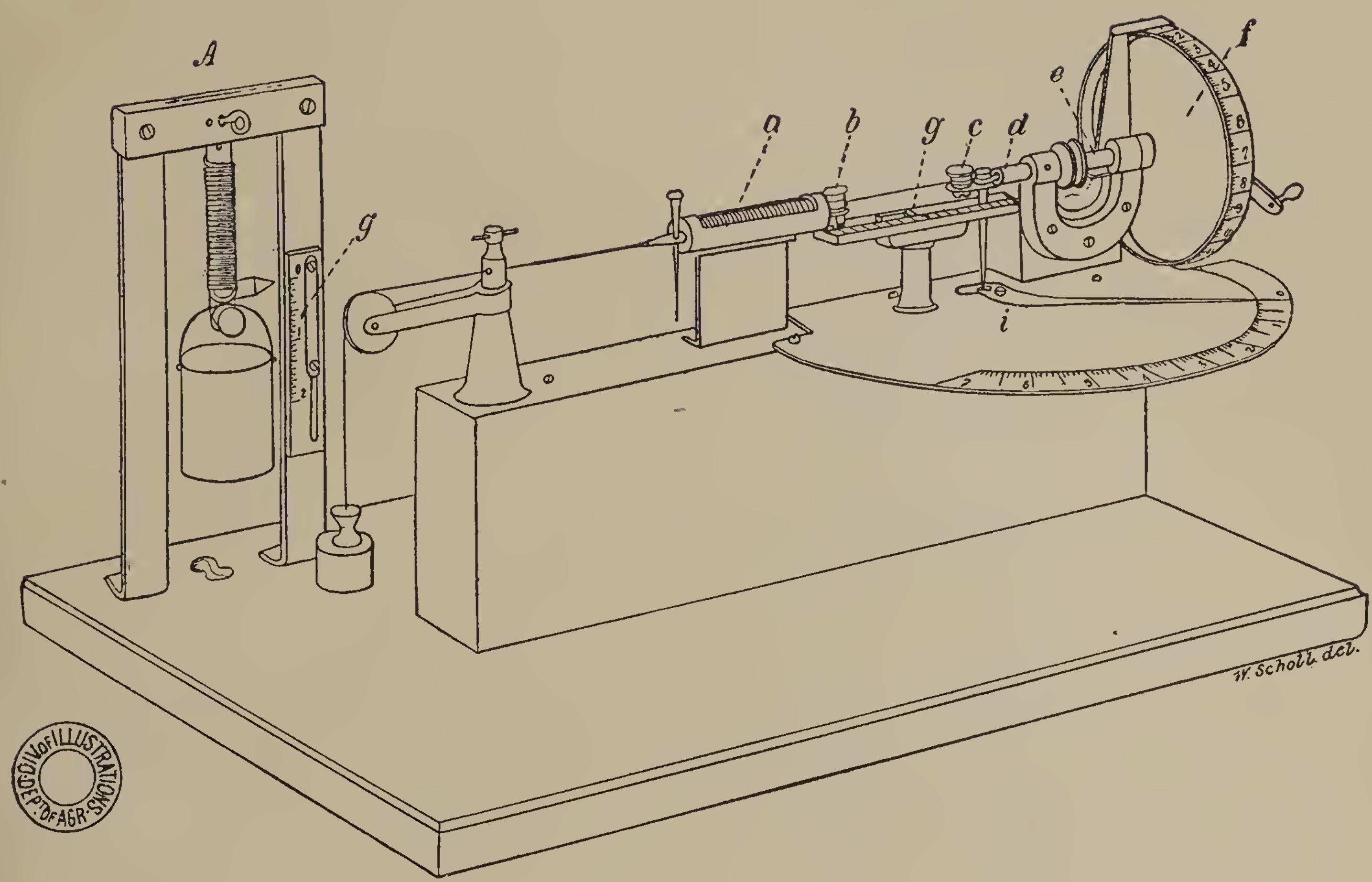


Fig. 1.

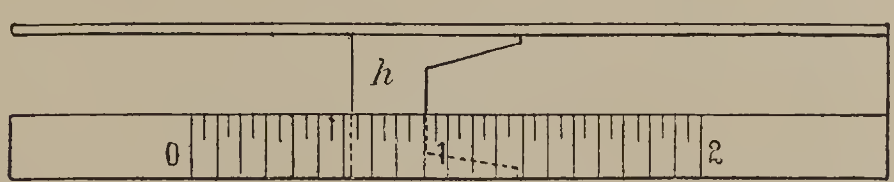


Fig. 2.

MACHINE FOR TESTING TENSILE STRENGTH OF TEXTILE FIBERS.

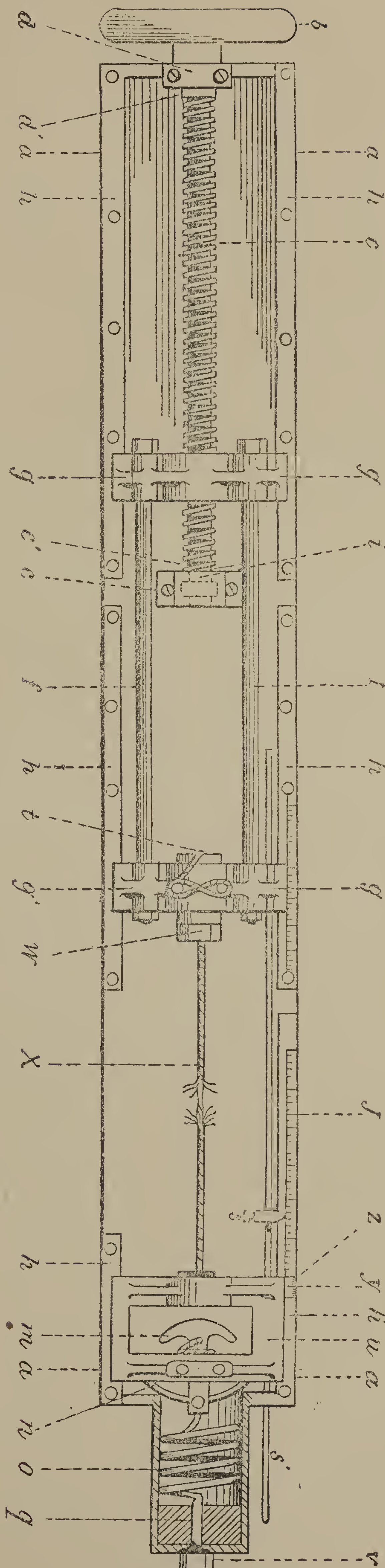


Fig.1.

Fig.2

MACHINE FOR TESTING BINDER TWINE.